“Fabrication, Characterization and Synthesis of metal oxide gas sensor”

Synopsis in candidature for the degree of
Doctor of Philosophy in Physics

Submitted
By

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Introduction

Increased environmental pollution, numerous motor vehicles, factory wastes and urbanization factors have been the source of high increases in the release of toxic, explosive and flammable gases in the environment of developed countries. High rate of gas emissions has both a negative impact on human/animal health and it can also have bad consequences on the environment and natural resources from day by day.

Gas sensors, the devices used to detect the hazardous and toxic gases present in the environment and expelled by the chemical industries and automobile fuel combustion. The rapid industrialization of our society has made it necessary for measurement technologies for monitoring of various gasses, fumes etc to grow in parallel. At present, detection of gases became a point of necessity to control the environmental balance [1-2]. The developments of miniature and portable gas sensors that are able to detect gases in real time with good sensing performance will significantly impact our daily life [3]. In the last few years there has been an explosion in the number of published papers dealing with non-metals for gas sensor application.

Need of Gas sensors:

There is a need for simple, sensitive and stable electronic sensors suited for trace detection in a wide spectrum of applications ranging from lab-on-a-chip and in vivo biosensors to environmental monitoring and warfare agent detection, as opposed to the often employed expensive, bulky and complicated instrumental methods. This need for inexpensive, low-power devices is fuelling the exponential growth of research in this area [4]. Researchers are trying to fabricate suitable materials that could be employed as better gas sensors with fast response, long-term stability, high sensitivity, and greater selectivity [5]. In recent years, numerous gases and volatile organic compounds (VOCs) have been utilized in large areas of industrial production and research applications as one of the reaction agents [6]. There is an important point to be concerned to control and monitor

these harmful species, considering a huge risk of damage to assets and human beings if a leak occurs. There are certain gases which can be toxic for humans, and can cause big explosions. Accordingly there is a need of gas sensors with the intention of continuous and effective detection of these gases to evade predominantly the above said dangers. An ideal gas sensor should posses the following sensing properties [7]:

- High Sensitivity to certain gases
- Reversibility
- Faster response time and good recovery time.
- High Selectivity
- Long term Stability
- Simple principle of operation
- Easy to handle.
- Simple fabrication techniques.
- Temperature insensitive.

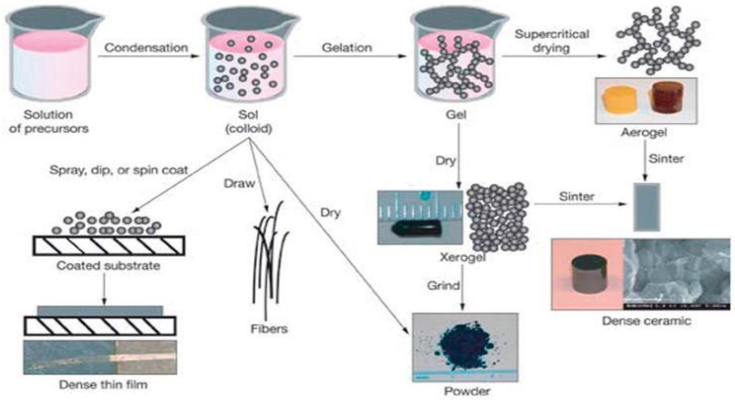
- **Methodology:**

Chemical synthesis

The chemical methods are simple and economical for the preparation of metal oxide. The chemical method are considered to be useful for fabrication of various materials useful for optical,catalytical,,magnetic and ferroelectrically materials. These materials have wide properties like physical,mechanical,electrical,magnetic and optical properties. These properties depends on doping ,heat treatment, sintering temperature and synthesis method. The various chemical methods are used to fabricate nanoparticles,nanotubes and nanorods.The solgel method is fascial method and having many advantages.

The sol–gel process is a wet chemical technique also known as chemical solution deposition, and involves several steps, in the following chronological order: hydrolysis and poly-condensation, gelation, aging, drying, densification, and crystallization.the sol–gel process is a method for producing solid materials from small molecules. The process involves conversion of monomers into a

colloidal solution (sol) that acts as the precursor for an integrated network (or gel) of either discrete particles or network polymers



• **Characterization**

Different measurement techniques to characterize the structural, magnetic, dielectric and electrical properties of the specimens can be employed.

[1] X-ray powder diffraction (XRD) is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions. The analyzed material is finely ground, homogenized, and average bulk composition is determined.

[2] A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons.

[3] The morphology, particle size and shape are revealed through field emission scanning microscopy (FE-SEM).Field emission scanning electron microscopy (FESEM)

provides topographical and elemental information at magnifications of 10x to 300,000x, with virtually unlimited depth of field. Compared with convention scanning electron microscopy.

[4] High resolution transmission electron microscopy (HR-TEM) is a powerful tool to study properties of materials on the atomic scale, such as semiconductors, metals, nanoparticles.

[5] Fourier transmission infrared (FTIR) provide information on the basis of chemical composition and physical state of the whole sample So all these above mentioned are the characterization techniques are very useful for knowing the material structure and properties of the material.

• **Tentative Plan of Action (For the duration of 3 Yrs.)**

1) Selection of materialsS

2) Synthesis of metal-oxide

3) CharacterizationSA

4) Collecting data and optimizing

5) Writing paper

6) Publishing in reputed journals

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